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UNITED STATES DEPARTMENT OF AGRICULTURE

BUREAU OF ENTOMOLOGY

FOREST INSECT INVESTIGATIONS

A PRELIMINARY STUDY OF THE LIFE HISTORY AND HABITS OF THE RED TURPENTINE BEETLE IN WESTERN YELLOW PINE

by

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January 10, 1928.

GOVERNMENT PRINTING OFFICE

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A PRELIMINARY STUDY OF THE LIFE HISTORY AND HABITS OF THE RED TURPENTINE BEETLE IN WESTERN YELLOW PINE

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Introduction

The Red Turpentine Beetle, Dendroctonus valens Lec., has been known to occur in most species of pine throughout the country. The damage that is done by this insect is very important in some species of pine and negligible in others. The Monterey Pine (Pinus radiata) of the Pacific Coast is an important host which suffers considerable damage from this bark borer. The Yellow Pine (Pinus ponderosa), on the other hand, is usually unharmed unless it is severely weakened by other insects, drought or old age. Most of the observations recorded in this paper were made on the yellow pine near North Fork, California, in the Sierra National Forest. The elevation ranges between 3600 and 5000 feet.

The purpose of this paper is to assemble data on D.valens Lec. that were gathered while engaged in a study of D. brevicomis Lec., directed by H.L. Person during the summer of 1927 on the Cascadel area. D. valens Lec. was found commonly in all trees killed by the western pine beetle. As literature has little to offer on the biology of D. valens, this gave an excellent opportunity to study its life history, and also its developments in relation to D. brevicomis Lec. Aside from pure life history studies, other subjects were taken into consideration during the period of this study. Notes were made on the types of trees attacked, the association of D.valens with other insects, and the direction in which the brood galleries are extended from attack ppints.

Frequent observations were made and data were collected during the summer between May 1 and August 15. After August 15 the study was discontinued, as it was necessary for the writer to go to the Modoc National Forest with H.L. Person for the purpose of laying out two 40-acre sample plot areas of yellow pine. The few summer months devoted to this study by no means afforded sufficient time to gain a complete knowledge of an insect with so complicated a life history as Dendroctonus valens Lec. The development is very slow, as will be seen, and the overlapping of generations is such that considerable time is required to find out why and where the pverlapping occurs. This paper serves only as an introduction to the study.

The data secured for life history studies were obtained in three ways. The first consisted in following through a brood which developed normally in a green stump under natural field conditions; the second source of information was supplied by introducing new adults into a caged green stump, and the third by gathering miscellaneous data from time to time during the summer.

LIFE HISTORY RECORDS

1. In Green Stump Under Natural Conditions

The stump from tree #J202 was selected to follow brood development under natural conditions. This tree had been killed to within 30 feet of the ground by an overwintering brood of D. brevicomis Lec., and was cut for brood counts on June 4. The stump, being green, served as an excellent attraction for D. valens. A few of them had already developed pitch tubes at the time the tree was felled.

The following table shows the development of a brood, commencing with the first attacks on June 4 and ending November 7, on which date Mr. Wagner observed full-grown larvae and new adults:

June 4, 1927	- -	Few attacks
16	- - -	Many attacks and eggs
July 12	- -	Larvae 1/3 grown
19	- - -	" 1/4-1/2 "
Aug. 1	- -	" 1/2-2/3 "
8	- - -	" 1/2-3/4 "
15	- -	" 1/2 to full-grown
Nov. 7	- - -	" Full-grown & new adults

(It is assumed that these will hibernate during the winter months)

2. In Cage on Green Stump

On July 2, 1927, a slow-growing yellow pine was cut for a trap-tree experiment with D. brevicomis. The stump was caged for the purpose of introducing new adults of Dendroctonus valens in order to get an accurate check on their development. Three freshly-emerged adults from pupae collected June 27 were admitted on July 2. These were very feeble, their body walls not having hardened enough to make them active. They atarted to work, however, and on the 7th of July one pitch tube had been formed. On the 8th another tube showed up.

On the 11th of July a stump from an overwintering D.brevicomis tree was found to have a brood of new adults ready to emerge. Twenty of these were collected and put into the cage, where they immediately started attacking. The following day two more pitch tubes showed up. Others kept appearing until the 16th of July. A total of eight pitch tubes had been formed by this time.

Three of the attacks were selected for following up the brood; these were numbered 1, 2 and 3 respectively. Attack #1 was started July 5; eggs were first noted on August 1 and again on the 15th, with no larvae thus far. Attack #2 was started July 12 and eggs were first noted August 1 and again on the 15th. Attack #3 was started July 7. No further examination of this attack was made until August 18, when larvae about one week old were observed. From this time until the 10th of October no further observations were made; on that date H.L. Person found half to fully grown larvae.

3. Length of Adult Life

In order to get a complete record of the adults, a somewhat longer time than the summer months is required. In stump #J202 the adults kept working and extending their galleries until all available space was taken in the cambium. On July 20 the last of the space was worked up for egg galleries. At this time the adubts were abundant. One of them was found dead. The stump was examined again on August 1 and was found to contain very few adults. Several were found dead in the galleries. This happened just two months after the first attacks were made. It is quite likely that the adults die shortly after a two-month active period.

The adults in the caged stump would probably have furnished sufficient data for length of life had time permitted. On August 15 the adults were still boring and laying eggs, having been there since the first week in July. When examined by Mr. Person on October 10 no parent adults were noted.

SUPPLEMENTARY FIELD OBSERVATIONS

1. Overwintering Broods

The following table shows the stages of broods that overwintered during 1926-27 in trees killed by D. brevicomis:

Date(1927)	Brood
June 2	Full-grown larvae and pupae
8	" " "
23	Pupae
27	" (ready to emerge)
30	New adults
July 11	"

2. Summer Broods

Other notes taken on D. valens during the summer show attacks as early as May 2, but no eggs were found until about June 1. The period of heaviest attack apparently begins about May 15 and lasts until the middle or latter part of June. From then on the number of attacks diminish, but some broods are developed continually during the summer.

3. Flight Notes

Notes taken on D. valens which were attracted to four of the cages constructed around trees for D. brevicomis experimental work during the first generation (May 1 to June 30) showed a definite heavy flight period apparently coinciding with the peak of the first D. brevicomis attack. Observations made on these trees, examined every few days from May 4 show a gradual increase and subsequent decrease in the number of beetles attracted to the outside of the cages during May and June. This is shown graphically in the D. valens flight chart (Fig. 5).

Other observations on the number of D. valens attracted to cages during the second generation of D. brevicomis (July 1 to August 15) showed that very few of them were attracted to the outside. This was probably due to the fact that very few D. valens were in flight during that period.

4. Brood Galleries

A point of interest with regard to which way brood galleries are extended from the points of attack is one that was given some consideration. Out of at least 25 different galleries that were examined, as many extended up from the attack points as down. Often the galleries extended up for some inches, then turned down. There seems to be no general rule other than the fact that the galleries are always vertical.

ATTACKS IN LIVING TREES

Observations made on D. valens attacks in green trees during the summer indicate that the beetles very frequently attack green trees, but are not able to overcome the pitch flow sufficiently to develop broods. There is, however, one definite case where a brood was developed in a green tree which was used as an attraction for D. brevicomis. On July 13 this tree, about which D. brevicomis brood bark had been piled, was noted by H.L. Person to have several D.valens attacks at the base. On September 9 Mr. Person again examined the tree and found that a brood of quarter- to half-grown larvae had developed, killing a small area of cambium. The tree was still healthy.

RELATION OF D. VALENS LEC. TO OTHER INSECTS AFFECTING YELLOW PINE

The stem analyses of sixteen yellow pines which had Dendroctonus valens in the base were made in an effort to determine the relation of D. valens to the other insects found. Figures 2, 3 and 4 show the distribution of the insects in these trees. The intensity of lines or dots in the figures indicates the degree of infestation. The dates at the base of each diagram indicate when the tree was felled. Each tree was given a number. The letter J before a number indicates that the tree was killed in 1926; the letter K that the tree was killed in 1927; the letters TJK that the tree was top-killed in 1926 and finally killed in 1927. The letters in tree KPA-1 were used to identify it as a pitch-tube attraction experiment for D. brevicomis.

The most important insect in each case is D. brevicomis. The others in the order of their importance are Ips confusus, Buprestids, D. monticolae and D. valens. A comparison of the stages of development in D. valens with other insects along the trunks of these trees showed that D. valens in most cases had the youngest broods, indicating that they were the last or very nearly the last insects to attack the trees. There is reason to believe that the presence of any single species of insect or several species is influential in causing

D. valens to attack on account of the scent of fresh pitch tubes. D. valens is purely a secondary insect, and is rarely able to make successful attacks until the tree has been overcome by some other agency.

SUMMARY AND CONCLUSIONS

1. Life history studies were carried on with the red turpentine beetle in yellow pine between May 1 and August 15, 1927, near Northfork, California, at an elevation ranging between 3600 and 5000 feet.

2. Broods that overwintered during 1926-27 were found from May 1 to July 15. Fully mature adults were first observed to attack trees on May 2. These insects probably overwintered in the adult stage. Fully grown larvae and pupae were found during June. It is quite likely that these broods overwintered in the larval stage. The pupae commenced to transform into adults the latter part of June and continued until July, when the last new adults were noted.

3. Studies of summer brood developments were carried on in two stumps. In one the brood developed to the full-grown larvae stage between June 4 and August 15. Fully grown larvae and new adults were found November 7. In the other stump a brood of half- to full-grown larvae had developed between July 5 and October 10. Each of the two broods will probably overwinter in the stages last noted.

4. The egg-laying period of the adult is about 2 months, and the larvae that develop from these are found in all sizes in the same brood galleries. This condition causes a general stringing-out of broods, so that there are continuous developments in all stages.

5. These data indicate that there is one generation of D. valens per year, with partial development of a second. Although no close study of the brood in stump #J202 was made after August 15, it is quite reasonable to suppose that a portion of the larvae pupated and emerged as adults during the latter part of September and October to start new attacks and broods. This must be the case, for a large percentage of the larvae were very nearly fully grown on August 15.

Fig. 1 gives a graphical representation of the life history studies summarized in this paper.

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Fig 1. - Life History Chart For Ovalens

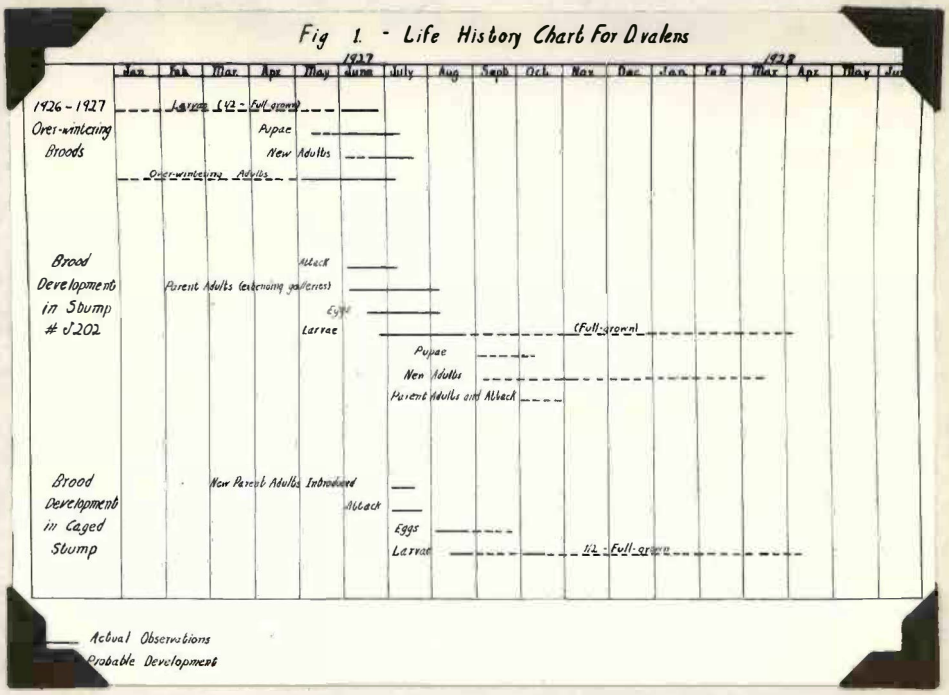

Fig 2 - Stem Analysis Showing

Distribution of Insects in Yellow Pine Killed by D. brevicomis

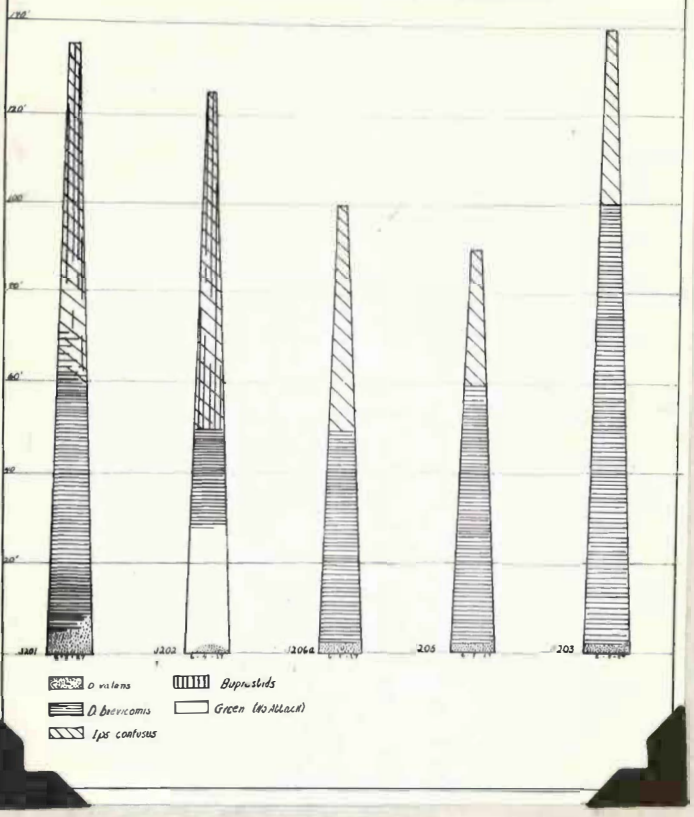

Fig 3 - Stem Analysis Showing

Distribution of Insects in Yellow Pine Killed by D. brevicomis

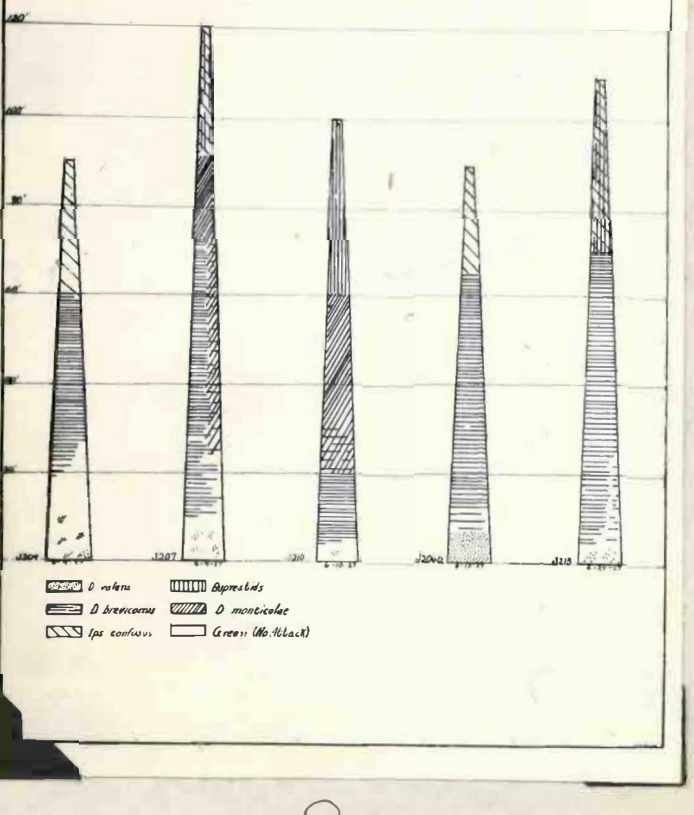

Fig 4. - Stem Analysis Showing

Distribution of Insects in Yellow Pine Killed by D brevicomis

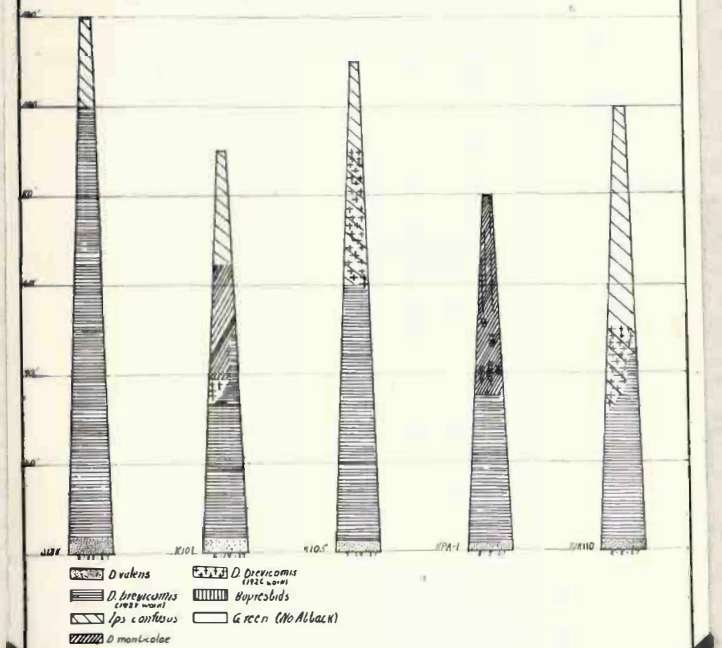

Fig. 5

D valens Flight Chart